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(54) Pumping gas/liquid mixtures

(57) In order to pump gas/liquid mixtures of relative concentrations which are not best suited to efficient operation of the pump, apparatus is provided to split the mixture into a relatively gas rich branch 14 and a relatively gas reduced branch 15. The pump 16 is located in the branch where the concentration is better suited to its efficient operation. The mixtures in the branches are combined downstream of the pump, preferably by an injector 17.

The pump could be a compressor (16', Fig. 2) located in the relatively gas rich branch 14.

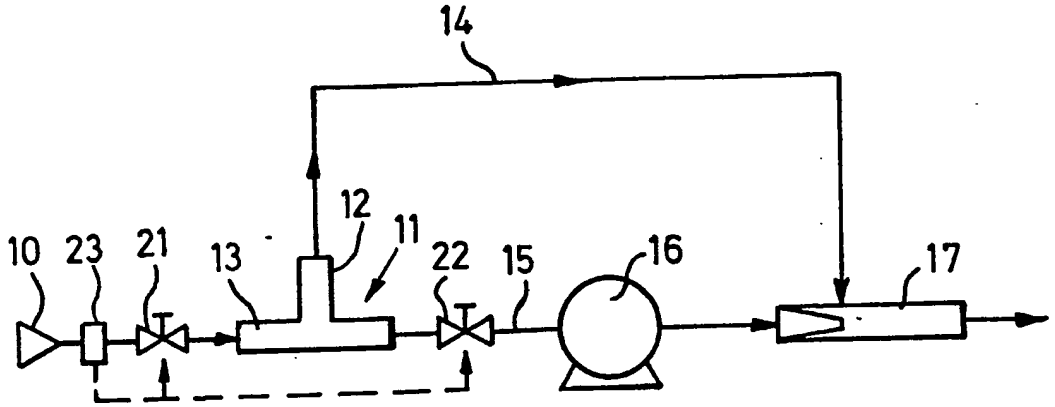

FIG.1

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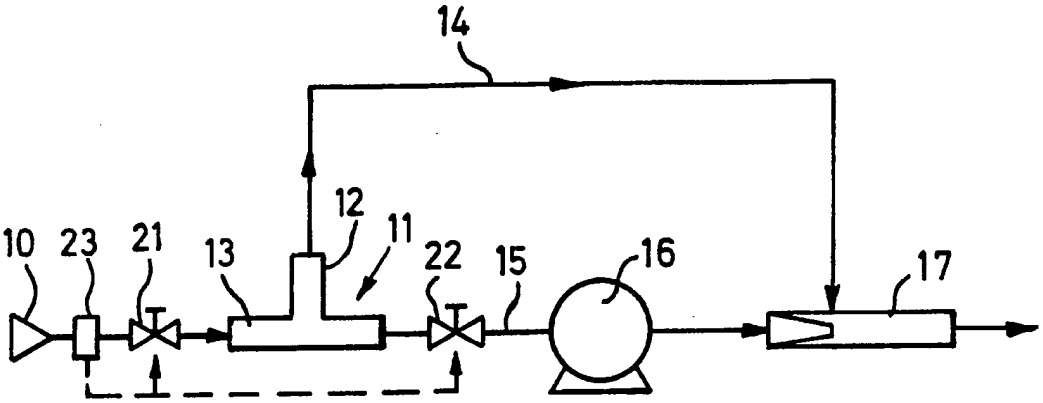

FIG.1

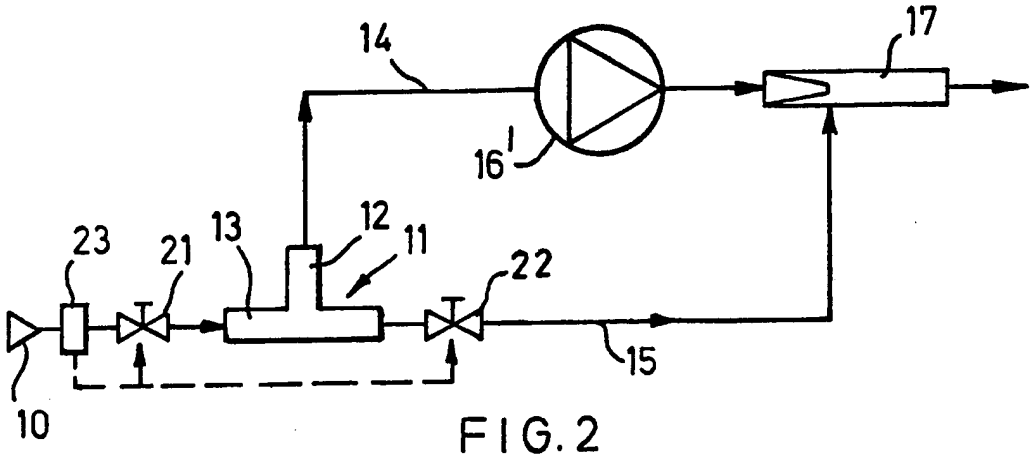

FIG.2

PUMPING LIQUID/GAS MIXTURE

The performance of pumps is affected when the liquid to be pumped contains gas. A rotodynamic pump can, it is believed, pump liquid/gas mixtures in which the gas proportion does not exceed 50% by volume, but there is a demand for pumping liquid gas mixtures with up to 90% gas by volume.

The present invention attempts the improve the pumping of gas/liquid mixtures, and provides apparatus for pumping gas/liquid mixtures comprising an inlet leading to a gas/liquid separator which provides a gas-rich output to a first conduit and a gas-reduced output to a second conduit, a pump in one of said conduits and means for combining the flows from said conduits downstream of the pump.

An example of the invention will now be described with reference to the accompanying drawings in which:-

Figures 1 and 2 are schematic diagrams of alternative pumping systems.

As shown in Figure 1, a gas separator 11 is in the form of a T, with its stem 12 extending vertically upwards. A gas/liquid mixture from an inlet conduit 10 enters one end of the cross-piece 13 of the T and gas is encouraged to escape up the stem 12 to a first conduit 14 leaving a gas-reduced mixture to pass across the cross-piece to a second conduit 15. A pump 16 is located in the second conduit 15. The two conduits 14, 15 lead to an injector17 where the pumped gas-reduced mixture draws the gas from the first conduit 14 back into the mixture.

The operation can be enhanced by providing valves 21 and 22 respectively upstream and downstream of the T-junction 11 in the inlet conduit 10, together with a gas liquid ratio sensor 23 in the conduit 10 upstream of the valves 21 and 22. The sensor controls the operation of the valves 21 and 22 according to the sensed ratio. The upstream valve 21 is intended to reduce the pressure as the mixture approaches the T-junction, thereby encouraging the gas to separate. The downstream valve 22 is intended to inhibit the flow of gas therethrough, thereby encouraging the gas in the mixture to divert to the stem 12.

The pump 16 which is a bubbly pump is located in the gas-reduced flow and so its performance is not adversely affected as it would be if it had been located in the gas-liquid mixture at the inlet of the gas separator. In an alternative arrangement shown in Figure 2, pumping is performed by a compressor 16, located in the gas-rich flow of the first conduit 14 so that its performance will not be so adversely affected as it would be if it had been located in the gas-reduced conduit 15. In this alternative arrangement, the separated gas is pumped to the jet pump and draws in the gas-reduced liquid which simply flows without being pumped through the second conduit 15.

Gas separation can be improved by providing a series of T-shaped separators along the inlet conduit 10, all feeding one injector.

Alternative forms of gas separators can be used. A T-junction with its stem extending vertically downwards is suitable, in which case the liquid phase flows into the stem 12 to the first conduit 14 and the separated-out gas passes across the cross-piece of the T to the second conduit 15. The orientation of the T can be changed to any arrangement which causes gas to separate, and might be replaced by a conduit having a portion of enlarged diameter to encourage the separation of gas.

The pump may be any type of pump/compressor or multi-stage device, although a centrifugal rotodynamic pump may be preferred in view of its cost and simplicity of design.

Flow meters may be located in the conduits 14 and 15 as desired.

CLAIMS

1. Apparatus for pumping gas mixtures comprising an inlet leading to a gas/liquid separator which provides a gas rich output to a first conduit and a gas reduced output to a second conduit, a pump in one of said conduits and means for combining the flows from said first and second conduit downstream of the pump.

2. Apparatus as claimed in claim 1 wherein the pump is a compressor and is located in said first conduit.

3. Apparatus as claimed in claim 1 wherein the pump is a bubbly pump and is located in said second conduit.

4. Apparatus as claimed in any one of claims 1 to 3 wherein the combining means comprises an injector device, in which the mixture from the conduit containing the pump draws in mixture from the other said conduit.

5. Apparatus as claimed in any one of claims 1 to 4 wherein the separator comprises a T-shaped junction, the inlet being connected to one end of the cross-piece of the T.

6. Apparatus for pumping gas mixtures substantially as herein described with reference to the accompanying drawings.

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